

LT1178/LT1179

ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage	$\pm 22V$	Operating Temperature Range	
Differential Input Voltage	$\pm 30V$	LT1178I/LT1179I	$-40^{\circ}C$ to $85^{\circ}C$
Input Voltage	Equal to Positive Supply Voltage	LT1178C/LT1178S/LT1179C/LT1179S	$0^{\circ}C$ to $70^{\circ}C$
Input Voltage	5V Below Negative Supply Voltage	Storage Temperature Range	$-65^{\circ}C$ to $150^{\circ}C$
Output Short-Circuit Duration	Indefinite	Lead Temperature (Soldering, 10 sec.)	$300^{\circ}C$

PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>OUT A 1, -IN A 2, IN A 3, V- 4, +IN B 5, -IN B 6, OUT B 7, V+ 8</p> <p>N PACKAGE 8-LEAD PDIP T_{JMAX} = 100°C, θ_{JA} = 150°C/W</p> <p>H PACKAGE 8-LEAD TO-5 METAL CAN</p> <p>J PACKAGE 8-LEAD CERDIP</p>	<p>ORDER PART NUMBER</p> <p>LT1178ACH LT1178CH</p>	<p>ORDER PART NUMBER</p> <p>LT1178ACN8 LT1178CN8 LT1178IN8</p> <p>LT1178ACJ8 LT1178CJ8</p>	<p>TOP VIEW</p> <p>+IN A 1, V- 2, +IN B 3, -IN B 4, OUT B 5, V+ 6, OUT A 7, -IN A 8</p> <p>S8 PACKAGE 8-LEAD PLASTIC SO T_{JMAX} = 150°C, θ_{JA} = 200°C/W</p>	<p>ORDER PART NUMBER</p> <p>LT1178S8</p>	<p>ORDER PART NUMBER</p> <p>LT1178S8</p> <p>PART MARKING</p> <p>1178</p>
<p>OBSELETE PACKAGE</p> <p>Consider the N8 or S8 Package for Alternate Source</p>					
<p>TOP VIEW</p> <p>OUT A 1, -IN A 2, +IN A 3, V+ 4, +IN B 5, -IN B 6, OUT B 7, OUT C 8, -IN C 9, +IN C 10, V- 11, +IN D 12, -IN D 13, OUT D 14</p> <p>N PACKAGE 14-LEAD PDIP T_{JMAX} = 110°C, θ_{JA} = 130°C/W</p> <p>J PACKAGE 14-LEAD CERAMIC DIP</p>	<p>ORDER PART NUMBER</p> <p>LT1179ACN LT1179CN LT1179IN</p>	<p>Not Recommended. Use LT1178S8 for New Designs.</p> <p>TOP VIEW</p> <p>NC 1, NC 2, OUT A 3, -IN A 4, +IN A 5, V- 6, NC 7, NC 8, NC 9, NC 10, +IN B 11, -IN B 12, OUT B 13, V+ 14, NC 15, NC 16</p> <p>SW PACKAGE 16-LEAD PLASTIC SO WIDE T_{JMAX} = 150°C, θ_{JA} = 90°C/W</p>	<p>ORDER PART NUMBER</p> <p>LT1178SW LT1179SW</p>	<p>TOP VIEW</p> <p>OUT A 1, -IN A 2, +IN A 3, V+ 4, +IN B 5, -IN B 6, OUT B 7, NC 8, NC 9, OUT C 10, -IN C 11, +IN C 12, V- 13, +IN D 14, -IN D 15, OUT D 16</p> <p>SW PACKAGE 16-LEAD PLASTIC SO WIDE T_{JMAX} = 150°C, θ_{JA} = 90°C/W</p>	
<p>OBSELETE PACKAGE</p> <p>Consider the N14 Package for Alternate Source</p>		<p>OBSELETE PACKAGE</p> <p>Consider the N14 Package for Alternate Source</p>		<p>LT11778/1179 • P0101</p>	

Consult LTC Marketing for parts specified with wider operating temperature ranges. Please note that the LT1178S8 surface mount pinout differs from that of the LT1178 standard plastic or ceramic dual-in-line packages. For similar performance with standard pinout, see the LT2178.

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V; V_{CM} = 0.1V, V_O = 1.4V, T_A = 25^{\circ}C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 2)	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178		30	70	40	120	μV	
		LT1179		35	100	40	150	μV	
		LT1178SW				80	450	μV	
		LT1179SW				90	600	μV	
		LT1178S8				60	180	μV	
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.5		0.6		$\mu V/Mo$	
I_{OS}	Input Offset Current			0.05	0.25	0.05	0.35	nA	

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V; V_{CM} = 0.1V, V_O = 1.4V, T_A = 25^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 2)	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
I_B	Input Bias Current			3	5		3	6	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz (Note 3)		0.9	2.0		0.9		μV_{p-p}
	Input Noise Voltage Density	$f_0 = 10\text{Hz}$ (Note 3) $f_0 = 1000\text{Hz}$ (Note 3)		50 49	75 65		50 49		nV/\sqrt{Hz} nV/\sqrt{Hz}
i_n	Input Noise Current	0.1Hz to 10Hz (Note 3)		1.5	2.5		1.5		pA_{p-p}
	Input Noise Current Density	$f_0 = 10\text{Hz}$ (Note 3) $f_0 = 1000\text{Hz}$		0.03 0.01	0.07		0.03 0.01		pA/\sqrt{Hz} pA/\sqrt{Hz}
	Input Resistance Differential Mode Common Mode	(Note 4)	0.8	2.0 12		0.6	2.0 12		$G\Omega$ $G\Omega$
	Input Voltage Range		3.5 0	3.9 -0.3		3.5 0	3.9 -0.3		V V
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0V$ to 3.5V	93	103		90	102		dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.2V$ to 12V	94	104		92	104		dB
A_{VOL}	Large Signal Voltage Gain	$V_O = 0.03V$ to 4V, No Load (Note 4) $V_O = 0.03V$ to 3.5V, $R_L = 50k$	140 80	700 200		110 70	700 200		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, 2k to GND Output Low, $I_{SINK} = 100\mu A$ Output High, No Load Output High 2k to GND		6.5 0.2 120 4.2 3.5	9 0.6 160 4.4 3.8		6.5 0.2 120 4.4 3.8	9 0.6 160	mV mV mV V V
SR	Slew Rate	$A_V = 1, C_L = 10pF$ (Note 4)	0.013	0.025		0.013	0.025		V/ μs
GBW	Gain Bandwidth Product	$f_0 \leq 5kHz$		60			60		kHz
I_S	Supply Current per Amplifier	$V_S = \pm 1.5V, V_O = 0V$		13 12	18 17		14 13	21 20	μA μA
	Channel Separation	$\Delta V_{IN} = 3V, R_L = 10k$		130			130		dB
	Minimum Supply Voltage	(Note 5)		2.0	2.2		2.0	2.2	V

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ for I grades, $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ for SW grades, $V_S = 5\text{V}, 0\text{V}$; $V_{\text{CM}} = 0.1\text{V}$, $V_O = 1.4\text{V}$, unless noted. (Note 7)

SYMBOL	PARAMETER	CONDITIONS		LT1178I/LT1179I			LT1178SW/LT1179SW			UNITS		
				MIN	TYP	MAX	MIN	TYP	MAX			
V_{OS}	Input Offset Voltage	LT1178 LT1179	●		80	315		120	650	μV		
			●		80	345		130	800	μV		
$\Delta V_{\text{OS}}/\Delta T$	Input Offset Voltage Drift	(Note 6)	●		0.6	3.0		0.8	4.5	$\mu\text{V}/^{\circ}\text{C}$		
I_{OS}	Input Offset Current		●		0.07	0.7		0.06	0.50	nA		
I_{B}	Input Bias Current		●		4	8		3	7	nA		
CMRR	Common Mode Rejection Ratio	$V_{\text{CM}} = 0.05\text{V}$ to 3.2V I grade $V_{\text{CM}} = 0\text{V}$ to 3.4V S grade	●		84	98		86	100	dB		
PSRR	Power Supply Rejection Ratio	$V_S = 3.0\text{V}$ to 12V I grade $V_S = 2.5\text{V}$ to 12V S grade	●		86	100		88	102	dB		
A_{VOL}	Large-Signal Voltage Gain	$V_O = 0.05\text{V}$ to 4V , No Load (Note 4) $V_O = 0.05\text{V}$ to 3.5V , $R_L = 50\text{k}$	●		55	350		80	500	V/mV		
			●		35	130		45	160	V/mV		
	Maximum Output Voltage Swing	Output Low, No Load Output Low, $I_{\text{SINK}} = 100\mu\text{A}$ Output High, No Load Output High, 2k to GND	●			9	13		8	11	mV	
			●				160	220		140	190	mV
			●		3.9	4.2		4.1	4.3			V
			●		3.0	3.7		3.3	3.8			V
I_S	Supply Current per Amplifier		●		15	27		15	24	μA		

The ● denotes specifications which apply over the full operating temperature range of $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_S = 5\text{V}, 0\text{V}$, $V_{\text{CM}} = 0.1\text{V}$, $V_O = 1.4\text{V}$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178AC/LT1179AC			LT1178C/S8/LT1179C			UNITS		
				MIN	TYP	MAX	MIN	TYP	MAX			
V_{OS}	Input Offset Voltage	LT1178 LT1178S8 LT1179	●		50	170		65	250	μV		
			●					85	350	μV		
			●		60	200		70	290	μV		
$\Delta V_{\text{OS}}/\Delta T$	Input Offset Voltage Drift	(Note 6) LT1178S8	●		0.5	2.2		0.6	3.0	$\mu\text{V}/^{\circ}\text{C}$		
			●					0.6	3.5	$\mu\text{V}/^{\circ}\text{C}$		
I_{OS}	Input Offset Current		●		0.06	0.35		0.06	0.50	nA		
I_{B}	Input Bias Current		●		3	6		3	7	nA		
CMRR	Common Mode Rejection Ratio	$V_{\text{CM}} = 0\text{V}$ to 3.4V	●		90	101		86	100	dB		
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{V}$ to 12V	●		90	102		88	102	dB		
A_{VOL}	Large-Signal Voltage Gain	$V_O = 0.05\text{V}$ to 4V , No Load (Note 4) $V_O = 0.05\text{V}$ to 3.5V , $R_L = 50\text{k}$	●		105	500		80	500	V/mV		
			●		55	160		45	160	V/mV		
	Maximum Output Voltage Swing	Output Low, No Load Output Low, $I_{\text{SINK}} = 100\mu\text{A}$ Output High, No Load Output High, 2k to GND	●			8	11		8	11	mV	
			●				140	190		140	190	mV
			●		4.1	4.3		4.1	4.3			V
			●		3.3	3.8		3.3	3.8			V
I_S	Supply Current per Amplifier		●		14	21		15	24	μA		

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178SW LT1179SW LT1178S8		80	350		100	480	μV
							150	900	μV
							160	1050	μV
							120	350	μV
I_{OS}	Input Offset Current		0.05	0.25		0.05	0.35	nA	
I_B	Input Bias Current		3	5		3	6	nA	
	Input Voltage Range		13.5 -15.0	13.9 -15.3		13.5 -15.0	13.9 -15.3	V V	
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13.5V, -15V$	97	106		94	106	dB	
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	96	112		94	112	dB	
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$ $V_O = \pm 10V, \text{No Load}$	300	1200		250	1000	V/mV	
			600	2500		400	2500	V/mV	
V_{OUT}	Maximum Output Voltage Swing	$R_L = 50k$ $R_L = 2k$	± 13.0	± 14.2		± 13.0	± 14.2	V	
			± 11.0	± 12.7		± 11.0	± 12.7	V	
SR	Slew Rate	$A_V = 1$	0.02	0.04		0.02	0.04	V/ μs	
GBW	Gain Bandwidth Product	$f_0 \leq 5kHz$		85			85	kHz	
I_S	Supply Current per Amplifier			16	21		17	25	μA

The ● denotes specifications which apply over the full operating temperature range of $-40^\circ C \leq T_A \leq 85^\circ C$ for I grades, $0^\circ C \leq T_A \leq 70^\circ C$ for SW grades, $V_S = \pm 15V$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178I/LT1179I			LT1178SW/LT1179SW			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178	●	130	740		190	1150	μV
			LT1179	●	130	740		200	1300
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6)	●	0.7	4.0		0.9	5.5	$\mu V/^\circ C$
I_{OS}	Input Offset Current		●	0.07	0.7		0.06	0.35	nA
I_B	Input Bias Current		●	4	8		3	7	nA
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$	●	100	500		150	750	V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13V, -14.9V$	●	88	103		91	104	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	●	88	109		91	110	dB
	Maximum Output Voltage Swing	$R_L = 5k$	●	± 11.0	± 13.5		± 11.0	± 13.5	V
I_S	Supply Current per Amplifier		●	19	30		18	28	μA

LT1178/LT1179

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range of $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_S = \pm 15\text{V}$, unless noted.

The ● denotes specifications which apply over the full operating temperature range of $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_S = \pm 15\text{V}$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178AC/LT1179AC			LT1178C/S8/LT1179C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178S8	●	100	480	130	660	μV	
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6) LT1178S8	●	0.6	2.8	0.7	4.0	$\mu\text{V}/^{\circ}\text{C}$	
I_{OS}	Input Offset Current		●	0.06	0.35	0.06	0.35	nA	
I_B	Input Bias Current		●	3	6	3	7	nA	
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10\text{V}$, $R_L = 50\text{k}$	●	200	800	150	750	V/mV	
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13\text{V}$, -15V	●	94	104	91	104	dB	
PSRR	Power Supply Rejection Ratio	$V_S = 5\text{V}$, 0V to $\pm 18\text{V}$	●	93	110	91	110	dB	
	Maximum Output Voltage Swing	$R_L = 5\text{k}$	●	± 11.0	± 13.6	± 11.0	± 13.6	V	
I_S	Supply Current per Amplifier		●	17	24	18	28	μA	

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: Typical parameters are defined as the 60% yield of parameter distributions of individual amplifiers; (i.e., out of 100 LT1179s, or 100 LT1178s, typically 240 op amps, or 120, will be better than the indicated specification).

Note 3: This parameter is tested on a sample basis only. All noise parameters are tested with $V_S = \pm 2.5$, $V_O = 0\text{V}$.

Note 4: This parameter is guaranteed by design and is not tested.

Note 5: Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.7V supply but with a typical offset skew of $-300\mu\text{V}$.

Note 6: This parameter is not 100% tested.

Note 7: During testing at -40°C , the 5V power supply turn on-time is less than 0.5 seconds.

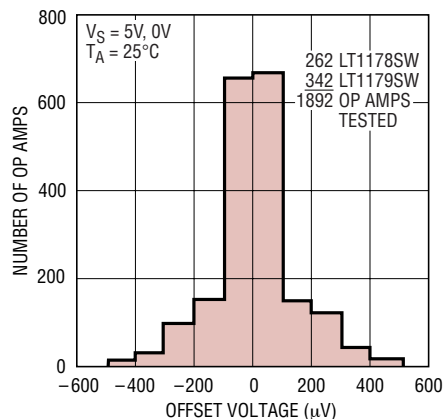
TYPICAL PERFORMANCE CHARACTERISTICS

Input Offset Voltage Distribution
N, J, H Package



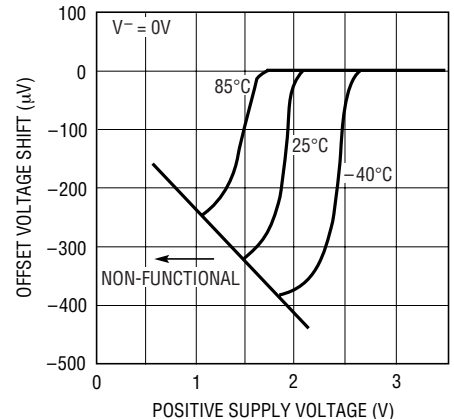
LT1178/LT1179 • TPC01

Input Offset Voltage Distribution
Surface Mount Package



LT1178/LT1179 • TPC02

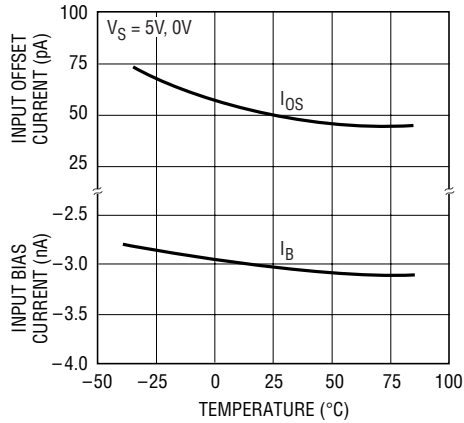
Minimum Supply Voltage



LT1178/LT1179 • TPC03

TYPICAL PERFORMANCE CHARACTERISTICS

Input Bias and Offset Currents vs Temperature



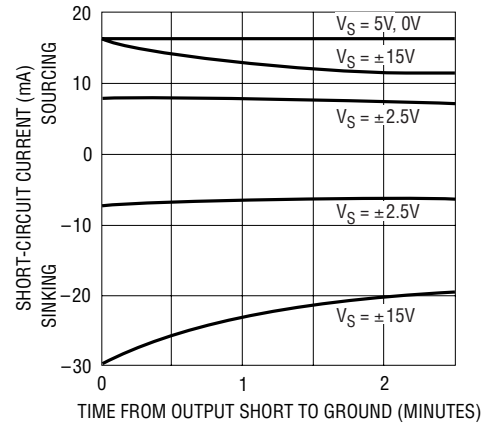
LT1178/LT1179 • TPC04

Output Saturation vs Temperature vs Sink Current



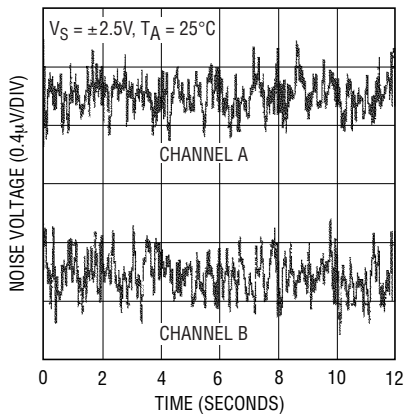
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Short-Circuit Current



LT1178/LT1179 • TPC06

0.1Hz to 10Hz Noise



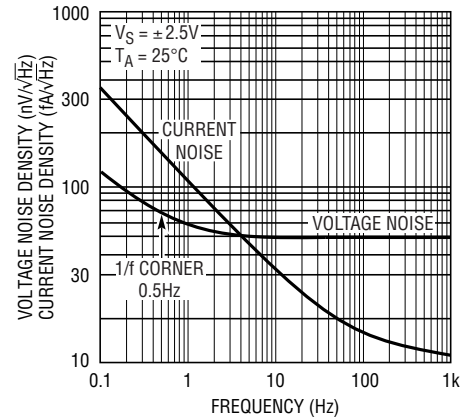
LT1178/LT1179 • TPC07

0.01Hz to 10Hz Noise



LT1178/LT1179 • TPC08

Noise Spectrum



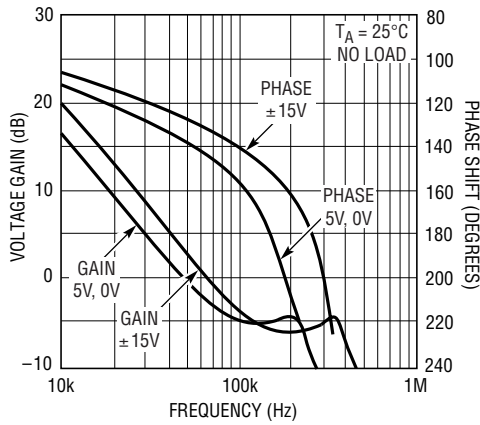
LT1178/LT1179 • TPC09

Voltage Gain vs Frequency



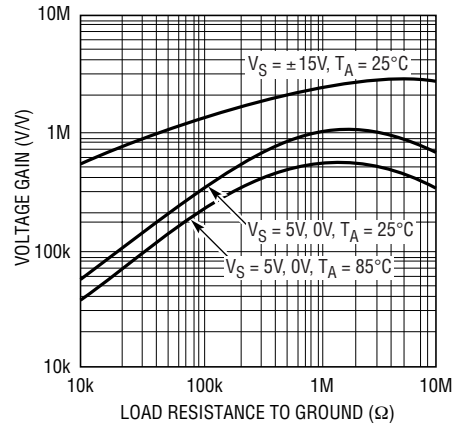
LT1178/LT1179 • TPC10

Gain, Phase vs Frequency



LT1178/LT1179 • TPC11

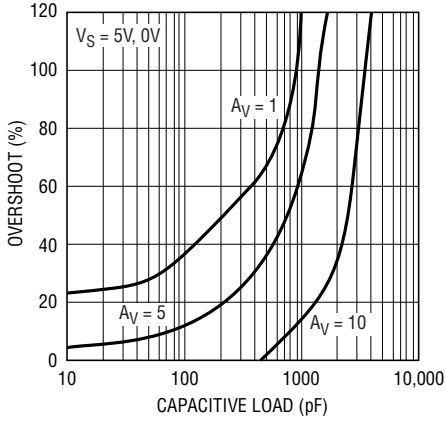
Voltage Gain vs Load Resistance



LT1178/LT1179 • TPC12

TYPICAL PERFORMANCE CHARACTERISTICS

Capacitive Load Handling



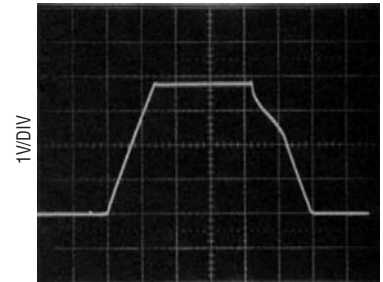
LT1178/LT1179 • TPC13

Large-Signal Transient Response
 $V_S = \pm 15V$



$A_V = 1$
 $C_L = 12pF$

Large-Signal Transient Response
 $V_S = 5V, 0V$



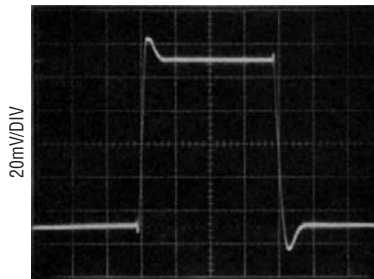
$A_V = 1$
 $C_L = 12pF$
INPUT PULSE = 0V TO 3.8V

Small-Signal Transient Response
 $V_S = \pm 2.5V$



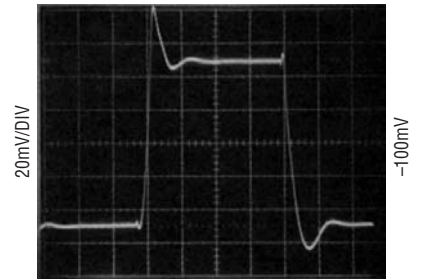
$A_V = 1$
 $C_L = 12pF$

Small-Signal Transient Response
 $V_S = \pm 15V$



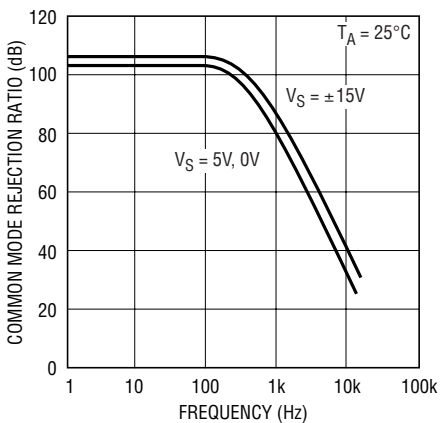
$A_V = 1$
 $C_L = 12pF$

Small-Signal Transient Response
 $V_S = 5V, 0V$



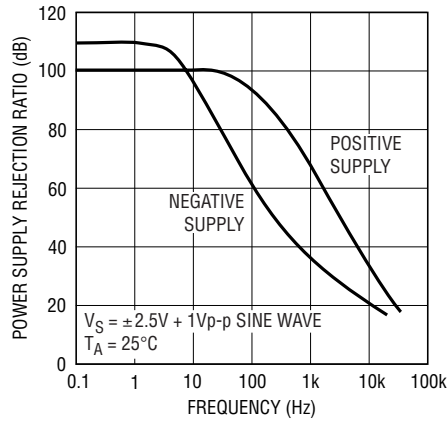
$A_V = 1$
 $C_L = 12pF$
INPUT 50 TO 150mV

Common Mode Rejection Ratio vs Frequency



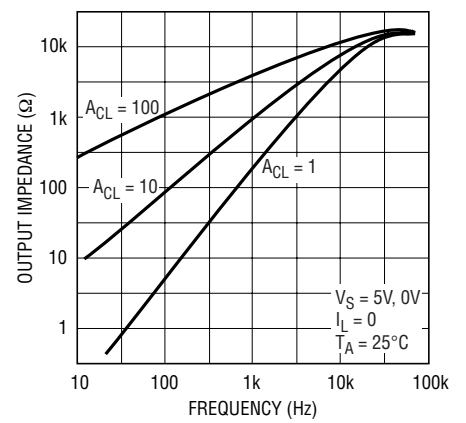
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Power Supply Rejection Ratio vs Frequency



LT1188/LT1189 • TPC20

Closed Loop Output Impedance



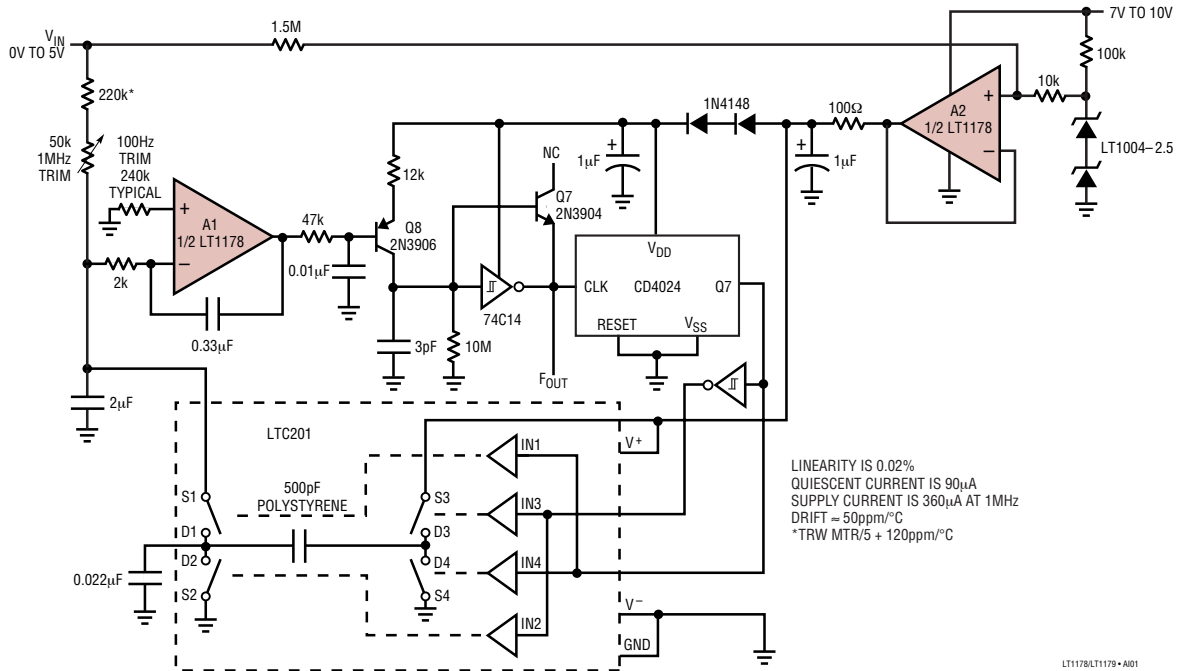
LT1178/1179 • TPC21

APPLICATIONS INFORMATION

Please see the LT1078/LT1079 data sheet for applications information. All comments relating to specifications, single

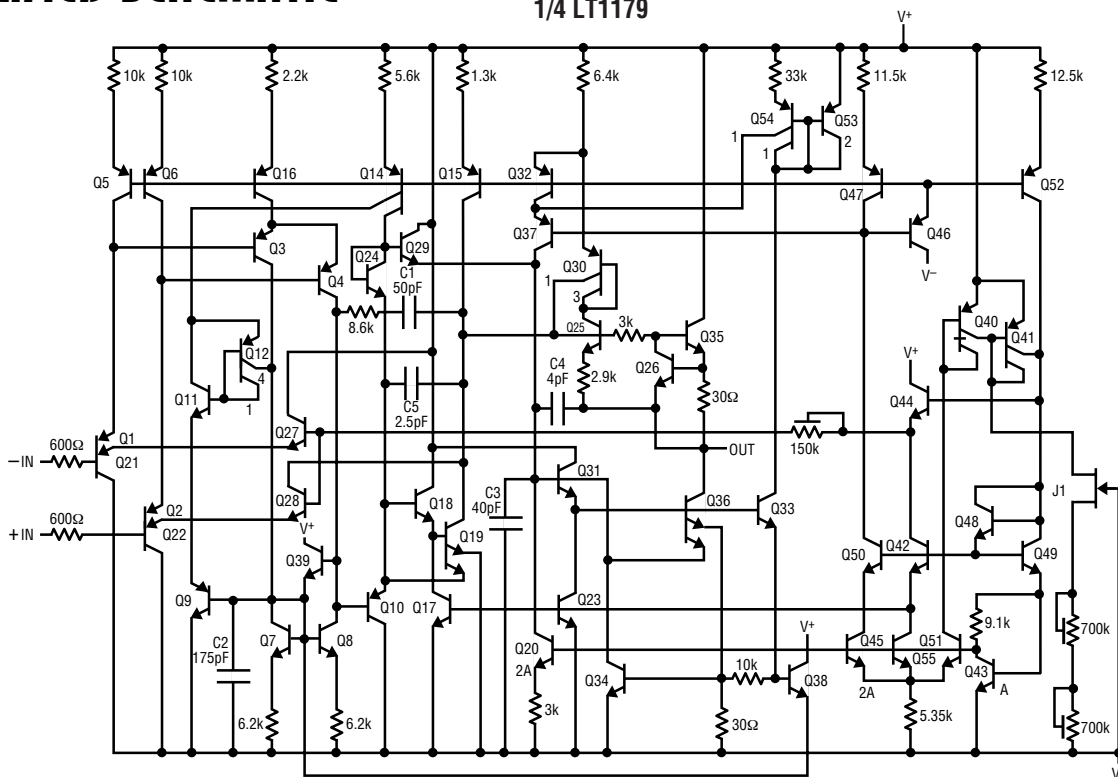
supply operation and phase reversal protection are directly applicable to the LT1178/LT1179.

Micropower 100Hz to 1MHz V-to-F Converter



SIMPLIFIED SCHEMATIC

1/2 LT1178
1/4 LT1179



PACKAGE DESCRIPTION

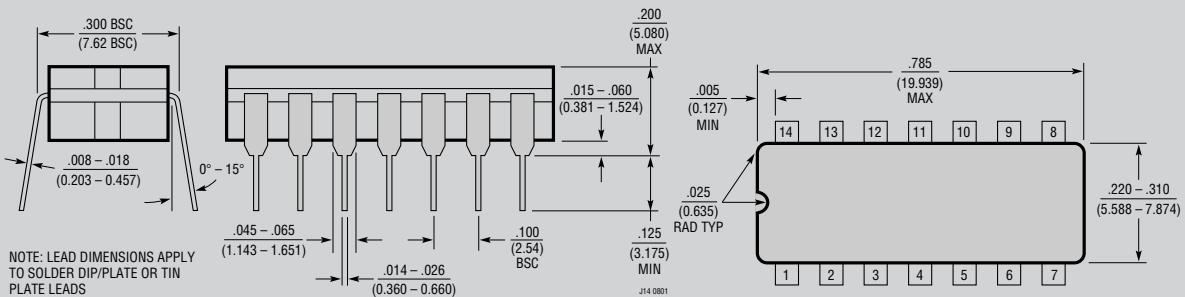
H Package
8-Lead TO-5 Metal Can (.230 Inch PCD)
 (Reference LTC DWG # 05-08-1321)



J8 Package
8-Lead CERDIP (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



J Package
14-Lead CERDIP (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



OBSOLETE PACKAGES

PACKAGE DESCRIPTION

N8 Package 8-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



NOTE:
1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

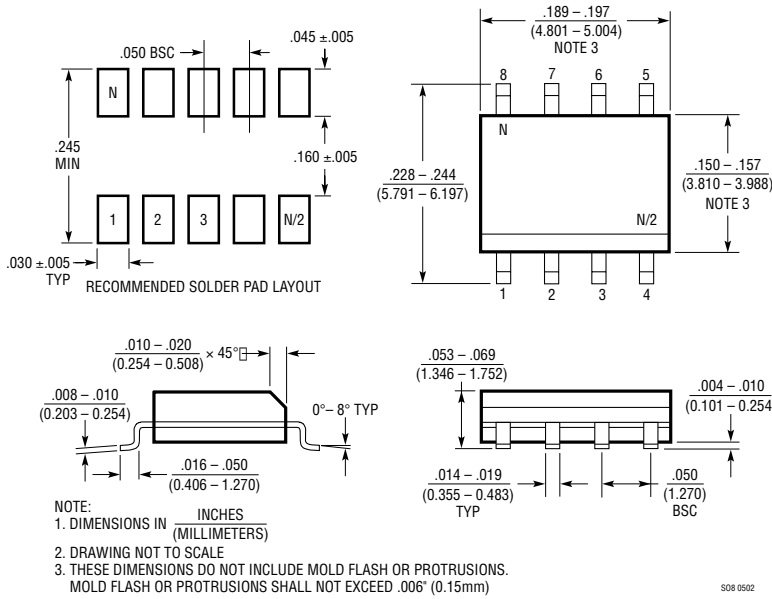
N Package 14-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



NOTE:
1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

PACKAGE DESCRIPTION

S8 Package
8-Lead Plastic Small Outline (Narrow .150 Inch)
 (Reference LTC DWG # 05-08-1610)



SW Package
16-Lead Plastic Small Outline (Wide .300 Inch)
 (Reference LTC DWG # 05-08-1620)

